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APPARATUS FOR TRIGGERING RESTRAINT DEVICES

Background Information

The present invention is based on an apparatus for triggering restraint devices according to the species defined in the independent claim.

DE 101 38 764 C1 describes an apparatus for triggering a restraint device featuring crash sensors inside and outside of the control unit. These crash sensors also generate, in addition to the crash signal, a plausibility signal for checking the crash signal.

Summary of the Invention

By contrast, the apparatus according to the present invention for triggering restraint devices having the features of the independent claim has the advantage that vehicle sensors external to the system generate the plausibility signal. These are vehicle sensors located outside of the restraint system, that is, they are neither located within the control unit, nor are they crash sensors located outside of the control unit. This can lead to speed advantages, but also to the complete elimination of the plausibility sensor.

The measures and refinements specified in the dependent claims allow for advantageous improvements of the apparatus for triggering restraint devices indicated in the independent claim.

Illustratingly, in the case of a side crash for instance, the plausibility could be assumed as given based on the information "vehicle is skidding" from a vehicle dynamics

control system (ESP= electronic stability program). This would eliminate the waiting time prior to the acceleration reaching a central sensor in the control unit of the restraint system. This represents a significant speed advantage and hence a faster triggering of restraint devices.

It is furthermore advantageous if the apparatus receives the plausibility signal from a knock control system. The engine control unit continuously analyzes the structure-borne sound signal at the engine block to detect engine knock and prevent it through control interventions. This signal could be checked for crash signatures for the purpose of deriving a plausibilization of the conventional triggering decision from it. This could eliminate the installation of an additional plausibility sensor.

If conventional plausibility sensors are used in addition, an overall plausibility signal may be generated through an OR operation on the plausibility signal of the crash sensor and of the vehicle sensor, which may be drawn upon in the triggering decision.

Brief Description of the Drawing

Exemplary embodiments of the present invention are shown in the drawing and are explained in more detail in the following description.

The figures show:

Figure 1 a block diagram of the apparatus according to the present invention and

Figure 2 a flowchart of the apparatus according to the present invention.

Description

Airbags have been part of the safety equipment of motor vehicles for years. For triggering the pyrotechnic system, an algorithm is processed in the software of the electrical control unit. The input variables for this algorithm are normally sensor signals for detecting crash severity, for example acceleration signals and pressure signals, as well as information regarding occupancy, the closing of seatbelt buckles etc.

To guard against false triggerings due to defective sensors, the most important principle to be followed is that the triggering decision must be plausibilized. Ideally, this is done via an independent sensor.

Essentially two problems are encountered in the plausibility concepts currently in use:

1. Additional Costs

If, for example, an additional X sensor is used for plausibilizing the acceleration signal in the X direction, i.e. in the direction of travel, costs are thereby incurred which only support the safety concept, but which provide no additional noticeable benefit to the customer.

2. Performance

If, for example, a peripheral sensor is used in the crash zone for detecting a side crash, this will indeed allow for a rapid triggering decision, but subsequently the system would still have to wait for the plausibility of the safety sensor in the

central unit. This is due to the fact that accelerations are measurable there only a few milliseconds afterwards.

The proposal according to the present invention is to exploit information quasi external to the system for plausibilizing the crash, instead of using a sensor of the restraint system for plausibilization. This could either lead to speed advantages or possibly even to the complete elimination of the plausibility sensor.

An example of such information external to the system is the signal of the ESP. Based on the information "vehicle skidding", the plausibility could be deduced as given in a side crash for example. This would eliminate the waiting time prior to the acceleration reaching the central sensor.

Another alternative is the structure-borne sound signal of the knock control system. This structure-borne sound signal, which is continuously recorded, can be checked for crash signatures to identify a crash or crash-related signals using pattern recognition. These could then serve as plausibility signal.

Figure 1 shows the apparatus according to the present invention in a block diagram. A control unit 11, usually mounted at the tunnel of the vehicle, is connected to a side-impact sensor 10 via a first data input. Via a second data input, control unit 11 is connected to a side-impact sensor 14 on the opposite side. In this context, side-impact sensors 10 and 14 may be acceleration sensors. Alternatively, they could be pressure sensors that detect an adiabatic pressure increase in a hollow body in the side panels of the vehicle resulting from the deformation of this hollow body in the course of a side impact. Other deformation sensors may be used as well for this purpose. Upfront sensors 12 and 13 attached to the radiator are connected to control unit 11 via

a third and a fourth data input. These are acceleration sensors that measure the acceleration at least in the direction of travel. It is possible that they are also capable of measuring accelerations transverse to the direction of travel, in the Y direction, and in the vertical direction. Via a fifth data input, control unit 11 is connected to an ESP control unit 15, and via a sixth data input, control unit 11 is connected to a knock control system 16.

Control unit 11 itself features a processor memory and its own sensors to process a triggering algorithm for restraint devices 17 from the crash signals of sensors 10, 12, 13 and 14. Restraint devices 17, to which control unit 11 is connected via a data output, are airbags, seatbelt tensioners and possibly a rollover bar. Sensors 10, 12, 13 and 14 are installed remotely so as to be closer to the crash location. This allows for faster registration of crash signals. The algorithm running in the processor of control unit 11, however, also requires plausibility signals for detecting failures or errors of crash sensors 10, 12, 13 and 14. For this purpose, control unit 11 may either use signals of the crash sensors themselves, for example the mutual plausibility of side-impact sensors 10 and 14, or also from sensors within control unit 11 itself, that is, from central sensors. The proposal according to the invention is now that signals of ESP control unit 15 for controlling the vehicle dynamics and of knock control system 16 may also be used for plausibility. ESP control unit 15 indicates the state of the vehicle dynamics and thus makes it possible to infer a possible crash. Knock control system 16 continuously monitors a structure-borne sound signal at the engine block, and this structure-borne sound signal may also contain crash signatures allowing for the identification of such a crash. If both or one of these are used, then possibly a plausibility via crash sensors can even be eliminated.

Figure 2 shows a flowchart of the process running in the apparatus according to the present invention. The algorithm for generating the triggering decision is run in block 20. To this end, control unit 11 receives triggering-relevant sensor signals from sensors 10, 12, 13 and 14. At the same time, a plausibility check is performed in blocks 21 and 22. This plausibility check is performed in block 21 on a conventional plausibility signal, i.e. on a signal of one of crash sensors 10, 12, 13 or 14 or of a central sensor in control unit 11. There, a mechanical switch, for example a Hamlin switch, may be used as well. In addition, a plausibility check is now performed in block 22 on the basis of the signals of ESP control unit 15 or of knock control system 16. The plausibility checks of blocks 21 and 22 are then combined in an OR operation in block 22. That is to say, if only one of blocks 21 or 22 indicates a plausibility signal, then the output of OR gate 23 will yield a logical one, indicating the presence of a plausibility signal for a crash. OR gate 23 is connected to a first input of an AND gate 24. Block 20, which outputs the triggering decision, is connected to a second input. If the triggering decision is YES and a plausibility signal was detected, then the instruction to fire is given at the output of AND gate 24. If no triggering decision was generated or if no plausibility signal is present, then no firing instruction is issued.

Alternatively, it is possible to use only lower block 22, in which case OR gate 23 may be eliminated. In that case, only the triggering decision of block 20 and the plausibility check of block 22 are combined in an AND operation. If both are present, an instruction to fire is issued. If only one is missing, no instruction to fire is issued.